

## **VEHICLE SECURITY DEVICE INCLUDING PRE-WARN INDICATOR AND RELATED METHODS**

### **Field of the Invention**

[0001] The present invention relates to the field of security systems and, more particularly, to vehicle security devices and related methods.

### **Background of the Invention**

[0002] Vehicle security systems are widely used to deter vehicle theft, prevent theft of valuables from a vehicle, deter vandalism, and to protect vehicle owners and occupants. A typical automobile security system, for example, includes a central processor or controller connected to a plurality of vehicle sensors. The sensors, for example, may detect opening of the trunk, hood, doors, windows, and also movement of the vehicle or within the vehicle. Ultrasonic and microwave motion detectors, vibration sensors, sound discriminators, differential pressure sensors, and switches may be used as sensors. In addition, radar sensors may be used to monitor the area proximate the vehicle.

**[0003]** The controller typically operates to give an alarm indication in the event of triggering of a vehicle sensor. The alarm indication may typically be a flashing of the lights and/or the sounding of the vehicle horn or a siren. In addition, the vehicle fuel supply and/or ignition power may be selectively disabled based upon an alarm condition.

**[0004]** A typical security system also includes a receiver associated with the controller that cooperates with one or more remote transmitters typically carried by the user as disclosed, for example, in U.S. Pat. No. 4,383,242 to Sassover et al. and U.S. Pat. No. 5,146,215 to Drori. The remote transmitter may be used to arm and disarm the vehicle security system or provide other remote control features from a predetermined range away from the vehicle. Also related to remote control of a vehicle function, U.S. Pat. No. 5,252,966 to Lambropoulos et al. discloses a remote keyless entry system for a vehicle. The keyless entry system permits the user to remotely open the vehicle doors or open the vehicle trunk using a small handheld transmitter.

**[0005]** In addition to providing an alarm indication, certain prior art security systems also provide a pre-warning indication which has a lesser volume or shorter duration than the alarm indication. The pre-warning indication is generally triggered by a sensed security threat level that is below a high security threat level needed to trigger the alarm indication. These high and low threat levels may be sensed using a two-stage shock sensor, for example.

**[0006]** The pre-warning feature is particularly advantageous for warning someone who comes too close to,

or makes contact with, the vehicle that the vehicle has a security system that can trigger a much more conspicuous alarm indication. Accordingly, if a would-be burglar bumps a vehicle window in an attempt to pick the door lock, a pre-warning indication is triggered to inform the perpetrator that breaking the window or opening the door will result in an alarm indication, and possibly other countermeasures as well.

[0007] Many vehicles currently include a keyless entry system, but not an alarm system that provides an alarm based upon sensed threats to the vehicle (i.e., a shock to a window, etc.). Moreover, certain vehicle alarm systems only have single-stage sensor inputs and thus do not provide any pre-warn features. That is, these alarm systems are designed to respond only to a high security threat level and, thus, only provide an alarm indication. Accordingly, to provide a pre-warn indication in a vehicle that already has one of these systems, the only way currently available to do so is to replace the system with one that is designed to provide such functionality. This may be cost prohibitive for many vehicle owners.

#### Summary of the Invention

[0008] In view of the foregoing background, it is therefore an object of the present invention to provide a vehicle security device and related methods which provide pre-warn features without having to replace an existing vehicle security system.

[0009] This and other objects, features, and advantages in accordance with the present invention are provided by a pre-warn vehicle security device for a vehicle which may include a data communications bus, an

alert indicator, and an alarm controller interfacing with the data communications bus. The alarm controller may cause the alert indicator to generate an alarm indication responsive to a high security threat level. More particularly, the pre-warn vehicle security device may include a housing and a multi-stage sensor carried by the housing. The multi-stage sensor may sense the high security threat level and communicate the sensed high security threat level to the alarm controller via the data communications bus. It may also sense a low security threat level lower than the high security threat level. Moreover, the pre-warn vehicle security device may also include a pre-warn indicator carried by the housing and connected to the multi-stage sensor for generating a pre-warn indication responsive to the sensed low security threat level.

**[0010]** Accordingly, the pre-warn vehicle security device may advantageously be used to provide pre-warning features in cooperation with pre-installed security systems that do not provide such functionality. That is, the multi-stage sensor still allows high security threat level events to be communicated to the alarm controller for generating alarm indications, as would be the case with an alarm controller having only a single-stage sensor input. Yet, since the pre-warn vehicle security device includes a multi-stage sensor and its own pre-warn indicator, it can also advantageously generate a pre-warn indication different from the alarm indication without having to modify or replace the alarm controller.

**[0011]** More particularly, the pre-warn indication may have a shorter duration than the alarm indication. Of course, the pre-warn indication may be distinguished from

the alarm indication in other ways. For example, the pre-warn indication may be audible (e.g., from a horn or siren), and the pre-warn indication may have a lesser volume than the alarm indication.

**[0012]** Additionally, the alarm controller may also generate a confirmation signal on the data communications bus upon switching between armed and disarmed operational modes. By way of example, the confirmation signal may be for causing a vehicle device (e.g., a vehicle light interfacing with the data communications bus) to provide a confirmation indication (e.g., a flash) to inform a user that the alarm controller has switched to a desired operational mode. As such, the pre-warn emulator may advantageously cause the pre-warn indicator to provide a confirmation indication responsive to the confirmation signal. Thus, for example, where an audible pre-warn indicator is used, the pre-warn vehicle security device may also advantageously be used to provide an audible confirmation indication to the user.

**[0013]** The alarm controller may switch between the armed and disarmed operational modes responsive to a mode change signal on the data communications bus. Similarly, the pre-warn emulator may also switch between armed and disarmed operational modes responsive to the mode change signal. Accordingly, the pre-warn emulator may advantageously cause the pre-warn indicator to provide a confirmation indication based upon switching between the armed and disarmed operational modes.

**[0014]** In accordance with another advantageous aspect of the invention, the vehicle may include at least one vehicle device interfacing with the data communications bus and generating a mode change signal on the data

communications bus. As such, the pre-warn vehicle security device may include an alarm circuit (such as the pre-warn emulator noted above) connected to the multi-stage sensor and interfacing with the data communications bus for switching between armed and disarmed operational modes responsive to the mode change signal. Moreover, the pre-warn vehicle security device may also include an indicator, such as the pre-warn indicator noted above, carried by the housing and connected to the alarm circuit.

**[0015]** Accordingly, when the alarm circuit is in the armed operational mode, it may cause the indicator to generate a pre-warn indication responsive to the sensed low security threat level, and to generate an alarm indication responsive to the sensed high security threat level. In addition, the alarm circuit may further cause the indicator to generate a confirmation indication upon switching between armed and disarmed operational modes.

**[0016]** The pre-warn vehicle security device may also include a signal enabler for enabling the pre-warn emulator to operate using a desired set of signals for communicating with the alarm controller via the data communications bus from a plurality of sets of signals for different alarm controllers. That is, different manufacturers typically use different codes for their alarm and keyless entry systems. The signal enabler thus allows the pre-warn emulator to "learn" the particular signals or codes appropriate for communicating with a given alarm controller. By way of example, the multi-stage sensor may be a multi-stage shock sensor. Additionally, the pre-warn indicator may be a siren, for example.

[0017] A method aspect of the invention is for upgrading a vehicle security system in a vehicle including a data communications bus. More particularly, the vehicle security system may include an alert indicator and an alarm controller for interfacing with the data communications bus and causing the alert indicator to generate an alarm indication responsive to a high security threat level. The method may include installing a pre-warn vehicle security device in the vehicle, such as the one described briefly above.

#### **Brief Description of the Drawings**

[0018] FIG. 1 is a schematic block diagram of a vehicle including a pre-warn vehicle security device in accordance with the present invention.

[0019] FIG. 2 is a schematic block diagram illustrating the pre-warn vehicle security device of FIG. 1 in greater detail.

[0020] FIG. 3 is a flow diagram illustrating operation of the pre-warn vehicle security device of FIG. 1 in accordance with one aspect of the invention.

[0021] FIG. 4 is a flow diagram illustrating operation of the pre-warn vehicle security device of FIG. 1 in accordance with another aspect of the invention.

[0022] FIG. 5 is a schematic block diagram of a vehicle including an alternate embodiment of the pre-warn vehicle security device in accordance with the present invention.

[0023] FIG. 6 is a schematic block diagram illustrating the pre-warn vehicle security device of FIG. 5 in greater detail.

**[0024]** FIG. 7 is a schematic block diagram of a vehicle including yet another alternate embodiment of the pre-warn vehicle security device in accordance with the present invention.

#### **Detailed Description of the Preferred Embodiments**

**[0025]** The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime notation is used to indicate similar elements in alternate embodiments.

**[0026]** Referring initially to FIG. 1, pre-warn vehicle security device **20** is for use with a vehicle **21** that includes a data communications bus **22**, an alert indicator **24**, and an alarm controller **25**. In particular, the data communications bus **22** is typically used to facilitate communications between numerous vehicle devices **23** without having to run dedicated wires throughout the vehicle **21**. By way of example, such vehicle devices **23** may include horns, doorlock motors, trunk releases, engine starters, etc. Further details regarding the use of data busses within vehicles may be found in U.S. Patent No. 5,719,551, which is assigned to the present assignee, the entirety of which is hereby incorporated herein by reference.



**[0027]** The alarm controller **25** cooperates with the alert indicator **24** to provide a security system for the vehicle **21**. As used herein, "vehicle security system" includes both car alarm systems and keyless entry systems, as well as combinations thereof. Thus, in the case of an alarm system, the alarm controller **25** would ordinarily cause the alert indicator **24** to provide an alarm indication responsive to a sensor input (e.g., shock sensor, motion sensor, etc.) indicating a high threat level. A high threat level could also be indicated to the alarm controller **25** by a user via a hand-held wireless transmitter (i.e., a key fob) having a panic button, for example. Many alarm and keyless entry systems provide such a panic feature.

**[0028]** In the case of an alarm system, the alarm controller **25** is preferably switchable between armed and disarmed modes. For example, the alarm controller **25** may enter the armed mode based upon the user turning off the ignition switch, or pressing the lock button on his wireless transmitter. Of course, the alarm controller **25** in either an alarm system or a keyless entry system may similarly be placed in an armed mode for responding to a panic event. Thus, the alarm controller **25** may provide an alarm indication any time the vehicle is off and a panic signal is received from a wireless transmitter, for example.

**[0029]** In accordance with the invention, the pre-warn vehicle security device **20** illustratively includes a pre-warn vehicle security sensor **26** for sensing a low threat level lower than the high security threat level. For example, if the pre-warn sensor **26** is a two-stage shock sensor for a vehicle window, the low security threat

level may be sensed if someone bumps or taps on the window (i.e., the first stage is triggered). In contrast, the high security threat level is only sensed if the second stage is triggered, such as by breaking the window.

**[0030]** Of course, other types of pre-warn sensors **26** may be used. For example, the pre-warn sensor **26** may be a motion or radar sensor for sensing the presence of a person near the vehicle **21** (i.e., a low security threat level). Other suitable sensors, such as those noted above, may also be used. On the other hand, similar sensors may be used to detect the presence of an unauthorized person within the vehicle, which would be a high security threat level.

**[0031]** The pre-warn vehicle device may further include a pre-warn emulator **27** which, responsive to the pre-warn vehicle security sensor **26**, generates one or more signals on the data communications bus **22** so that the alarm controller **25** causes the alert indicator **24** to generate an emulated pre-warn indication different from the alarm indication. By way of example, the pre-warn emulator **27** may be implemented using a microprocessor or other suitable logic/circuitry, as will be appreciated by those skilled in the art.

**[0032]** As noted above, a pre-warn indication is preferably distinguished from the alarm indication by a shorter duration, and/or lesser volume for example. This is because the pre-warn indication is intended to provide a would-be thief or vandal notice that the vehicle **21** has a security system, and that further action on his part will result in a very conspicuous alarm indication. Of course, the alarm controller **25** in some embodiments could

take further countermeasures, such as notifying a monitoring station or law enforcement of the high security threat level event via a wireless communications device (e.g., a cellular telephone) connected to the data communications bus **22**, for example.

**[0033]** By way of example, the alert indicator **24** may be an audible indicator such as a horn or siren. Of course, visual indicators such as vehicle lights or strobe lights may also be used, as will be appreciated by those skilled in the art. Further, more than one such alert indicator may be used, and different alert indicators could be used for different indications. For example, the alarm indication could be provided by a siren, and the pre-warn indication by a horn. It should also be noted that the alert indicator **24** may be directly connected to the alarm controller **25** as shown, or it may communicate with the alarm controller via the data communications bus **22** (FIG. 5).

**[0034]** Turning now additionally to FIG. 2, an exemplary embodiment of the pre-warn vehicle security device **20** also illustratively includes a housing **28** carrying the pre-warn sensor **26** and the pre-warn emulator **27** as well as a signal enabler **29** and a data bus interface **30**. Numerous materials such as plastic, metal, etc., may be used for the housing **28**, as will be appreciated by those skilled in the art. Generally speaking, the housing should be sufficiently rigid to protect the components carried thereby and allow mounting within the vehicle. To this end, the housing **28** may have holes formed therein for screws or other types of fasteners, for example, as will also be appreciated by those skilled in the art.

**[0035]** The data bus interface **30** provides signal connectivity between the pre-warn emulator **27** and the data bus **22**. In addition, the signal enabler **29** enables the pre-warn emulator **27** to operate using a desired set of signals for communicating with the alarm controller **25** via the data communications bus **22** from a plurality of sets of signals for different alarm controllers. That is, various manufacturers typically use different codes for their alarm and keyless entry systems. The signal enabler thus allows the pre-warn emulator to learn the appropriate signals or codes for communicating with a given alarm controller. The signal enabler **29** may be implemented in a similar fashion to that described in U.S. Patent No. 5,719,551, noted above, as will be appreciated by those skilled in the art.

**[0036]** Operation of the pre-warn security device **20** will be further understood with reference to the operational flow diagram of FIG. 3. In accordance with one aspect of the invention, operation begins (Block **40**) with the pre-warn sensor **26** sensing a security threat level, at Block **41**. If a high security threat level is sensed, at Block **42**, the pre-warn emulator **27** generates the appropriate signal or code on the data communications bus **22** for causing the alarm controller **25** to cause the alert indicator **24** to provide the alarm indication, at Block **43**.

**[0037]** It should be noted that the appropriate code for indicating a high security threat level will vary depending upon the particular alarm controller **25** being used. That is, different alarm controllers may cause an alarm indication based upon different codes. For example, some alarm controllers respond to a door open code from a

door pin switch when in an armed mode as an indication of a high security threat level (i.e., indicating that an unauthorized person has entered the vehicle **21**). In any event, the signal enabler **29** allows the pre-warn emulator to use the appropriate codes for a given alarm controller **24**, which may be downloaded or set during installation, as will be appreciated by those skilled in the art.

**[0038]** If the low security threat level is instead sensed by the pre-warn sensor **26**, at Block **44**, the pre-warn emulator **27** generates one or more armed mode signals, at Block **45**. As noted above, many alarm controllers provide a chirp upon receiving an armed mode signal to acknowledge that the system has been placed in an armed mode. In the illustrated embodiment, the pre-warn emulator **27** causes the alarm controller **25** to provide one or more chirps as the pre-warn indication. Similarly, keyless entry systems often provide a chirp to acknowledge that a door lock and/or unlock command has been received. Accordingly, for such an application, the armed signals provided by the pre-warn emulator **27** would correspond to such door lock or unlock signals.

**[0039]** Another approach to providing the pre-warn indication is illustrated in FIG. 4. Here, responsive to the pre-warn vehicle security sensor **26** indicating the low security threat level (Block **44'**), the pre-warn emulator **27** sequentially generates a high security threat level signal and a disarmed mode signal on the data communications bus **22**, at Block **50'**. That is, the high security threat level signal is used to cause an alarm indication, while the disarmed mode signal relatively quickly causes the alarm controller **25** to terminate the alarm indication.

**[0040]** In accordance with this aspect of the invention, the pre-warn indication is thus a shorter version of the alarm indication, such as about five seconds or less, for example. Not only may this pre-warn feature be used with a pre-existing alarm system that provides an alarm indication, but it may also be used with a keyless entry system providing a panic alarm indication, as noted above. That is, the pre-warn emulator may send a panic signal as the high security threat level signal, and the disarmed mode signal terminates the panic alarm indication.

**[0041]** An alternate embodiment of the pre-warn vehicle security device **20'** is illustrated in FIGS. 5 and 6. Here, the pre-warn vehicle security device **20'** includes a housing **28'** and a multi-stage sensor **26'** carried by the housing. The multi-stage sensor **26'** may sense the high security threat level and communicate the sensed high security threat level to the alarm controller **25'** via the data communications bus **22'**. This could be done using the pre-warn emulator **27'** to generate the high security threat level signal (HTLS). The pre-warn emulator **27'** may be connected to a high-threat level output (HTLO) **36'** of the multi-stage sensor, for example.

**[0042]** Moreover, the pre-warn vehicle security device **20'** also advantageously includes a pre-warn indicator **31'**, such as a siren, for example, carried by the housing **28'**. The pre-warn indicator **31'** is connected to a low threshold level output (LTLO) **35'** of the multi-stage sensor **26'**, which also generates a pre-warn indication responsive to a low security threat level signal (LTLS) therefrom. Thus, in accordance with this aspect of the invention, the pre-warn signal is provided by the pre-

warn indicator **31'**, while the alarm indication is provided by the alert indicator **24'**.

**[0043]** In accordance with another advantageous aspect of the invention, the alarm controller **25'** may generate a confirmation signal on the data communications bus **22'** upon switching between armed and disarmed operational modes. More particularly, the alarm controller **25'** may switch between the armed and disarmed modes responsive to a mode change signal on the data communications bus **22'**. By way of example, an armed mode change signal may be generated on the data communications bus **22'** responsive to the user pressing a door lock button on his key fob, and a disarmed mode signal may be generated responsive to a door unlock button being pressed.

**[0044]** The confirmation signal is for causing a vehicle device interfacing with the data communications bus **22'**, such as the vehicle light **23'**, to provide a confirmation indication (e.g., a flash) to inform the user that the alarm controller has switched to the desired operational mode. Accordingly, the pre-warn emulator **27'** may advantageously cause the audible pre-warn indicator **31'** to also provide an audible confirmation indication responsive to the confirmation signal on the data communications bus **22'**. It should be noted that the confirmation indication could be the same as the pre-warn indication, or it could be different, as desired.

**[0045]** In accordance with another advantageous aspect of the invention, the pre-warn emulator **27'** may also switch between armed and disarmed operational modes responsive to the mode change signal, similar to the alarm controller **25'**. Accordingly, the pre-warn emulator

**27'** may advantageously cause the pre-warn indicator **31'** to provide a confirmation indication based upon switching between the armed and disarmed operational modes. Here again, this allows the pre-warn vehicle security device **20'** to provide an audible confirmation indication in addition to the confirmation indication that would otherwise be provided by the alarm controller **25'** (e.g., one or more flashes of the vehicle light **23'**).

**[0046]** Turning now additionally to FIG. 7, another advantageous aspect of the invention in which the vehicle **21''** includes one or more vehicle devices, such as the wireless receiver **23''**, which interfaces with the data communications bus **22''** and generates a mode change signal on the data communications bus. By way of example, the wireless receiver **23''** may be for receiving lock/unlock signals from a user's key fob for activating a remote keyless entry (RKE) device (not shown). Thus, as discussed above, the lock signal would be an armed mode signal for the RKE device, while the unlock signal functions would be a disarmed mode signal for the RKE device.

**[0047]** The pre-warn vehicle security device **20''** may include an alarm circuit **70''**, similar to the pre-warn emulator **27** discussed above, connected to the multi-stage sensor **26''** and interfacing with the data communications bus **22''**. More particularly, the alarm circuit **70''** may switch between armed and disarmed operational modes responsive to the mode change signal from the wireless receiver **23''** (or other suitable vehicle devices, depending upon the given application). Moreover, the pre-warn vehicle security device also includes an indicator **71''**, similar to the pre-warn indicator **31** noted above,



carried by the housing 28'' and connected to the alarm circuit 70''.

[0048] In accordance with the present aspect of the invention, when the alarm circuit 70'' is in the armed operational mode, it causes the indicator 71'' to generate a pre-warn indication responsive to the sensed low security threat level. Moreover, when in the armed mode, the alarm circuit 70'' also causes the indicator 71'' to generate an alarm indication responsive to the sensed high security threat level. The pre-warn and alarm indications may be similar to those described previously above. In addition, the alarm circuit 70'' may further cause the indicator 71'' to generate a confirmation indication upon switching between armed and disarmed operational modes, again similar to that described above.

[0049] Thus, it will be appreciated by those skilled in the art that the pre-warn vehicle security device 21'' may advantageously be used to provide full alarm system capabilities (including sensing and indicating both pre-warn and alarm events) in a vehicle with no pre-existing alarm system. As in the illustrated example, the pre-warn security device 21'' thus provides a convenient and economical compliment for providing pre-warn and alarm features in a vehicle which already has an RKE device but no alarm system.

[0050] Even so, it should be noted that the pre-warn security device 21'' could also be used in vehicle with no RKE device whatsoever. For example, the mode change signal could be provided by an ignition switch connected to the data communications bus 22', which provides an armed mode signal for the alarm circuit 70'' upon being switched to the off position, and providing a disarmed

mode signal upon being switched to the on position. Thus, the alarm circuit 27'' would switch to the armed mode when the vehicle is turned off (i.e., when the owner is away from the vehicle), and it would switch to the disarmed mode once the owner returns to the vehicle and turns the ignition switch on. Of course, various other configurations and applications are also possible in addition to the examples provided above, as will be readily appreciated by those skilled in the art.

**[0051]** A method aspect of the invention is for upgrading a vehicle security system in a vehicle 20 including a data communications bus 22. The method includes installing a pre-warn security device 20 in the vehicle and interfacing the pre-warn security device with the data communications bus 22, as will be appreciated by those of skill in the art. Further method aspects will be readily apparent based upon the foregoing discussion and will therefore not be discussed further herein.

**[0052]** It will therefore be appreciated that the pre-warn vehicle security device 20 of the present invention is advantageously well suited for upgrading vehicles with pre-installed vehicle security systems to provide such pre-warn functionality. Moreover, this may be done relatively conveniently and inexpensively without installing an entirely new security system in the vehicle.

**[0053]** Additional features of the invention may be found in the co-pending application entitled VEHICLE SECURITY DEVICE HAVING PRE-WARN FEATURES AND RELATED METHODS, attorney docket number 58178, the entire disclosure of which is hereby incorporated herein by reference.

**[0054]** Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.